

**State of California
Department of Fish and Wildlife**

M e m o r a n d u m

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Subject: 2018 Yuba River Sturgeon Spawning Study

Purpose

The purpose of this report is to document findings regarding the second year of a California Department of Fish and Wildlife (CDFW) study to determine if southern Distinct Population Segment (sDPS) green sturgeon (*Acipenser medirostris*) and/or white sturgeon (*Acipenser transmontanus*) spawn in the Yuba River, and if so, what are the temporal, spatial, and habitat requirements associated with sturgeon spawning events.

Background

SDPS green sturgeon and white sturgeon populations have been severely reduced due to dams, diversions, habitat degradation, and both legal and illegal harvest. The Sacramento River system is the only river system supporting spawning of the federal threatened sDPS green sturgeon and is the primary river system supporting spawning of white sturgeon. Green sturgeon spawning has been documented in a 93 km section of the Sacramento River from Hamilton City (river kilometer [RK] 332.5) upstream to Cottonwood (RK 426) (Poytress et al. 2013) and in the Feather River in the vicinity of the Thermalito Bay Outlet in mid-June 2011 (Seesholtz et al. 2015). The majority of white sturgeon are thought to spawn in the middle Sacramento River between Knights Landing (RK 142) and Colusa (RK 237) (Schaffter 1997).

Because green sturgeon are federally listed as threatened, it is crucial to identify and support additional spawning populations. One of the Demographic Recovery Criteria points in the *Recovery Plan for Southern Distinct Population Segment of the North American Green Sturgeon (Acipenser medirostris)* includes “SDPS green sturgeon spawn successfully within two rivers in their historical range...”

Both sDPS green sturgeon and white sturgeon have been observed in the Yuba River, however; there is no documentation of either species spawning in the Yuba River. SDPS green sturgeon were observed in the Yuba River in 2011, 2016, and 2017; all three years with above average precipitation. In early May 2011, CDFW staff observed at least one SDPS green sturgeon below the Daguerre Point Dam (DPD) Pool (personal communication with Chris McKibbin). Cramer Fish Sciences conducted underwater video surveys 24-26 May 2011 and determined that there were at least four sDPS green sturgeon holding in the pool below the Daguerre Point Dam (Cramer Fish Sciences 2011). On 28 April 2016, CDFW staff conducted extensive DIDSON surveys of the pool below DPD but did not observe any sturgeon. However, the turbulence and bubble curtain created by water cascading over the dam prevented thorough DIDSON coverage of the pool. In July of 2016, CDFW divers conducted a visual survey of the pool below the Daguerre Point Dam and observed at least eight adult SDPS green sturgeon holding in the pool.

Suitable sturgeon spawning habitat typically consists of pools or deep runs with depths ranging from 1.8 to 11.2 meters and flow velocities of ≥ 1.0 meter per second with substrates consisting of gravel, cobble, and boulder (Poytress 2013, Schaffter 1997). Although DPD blocks upstream passage, the DPD plunge pool appears to be suitable sturgeon spawning habitat based on the combination of depth, flow turbulence, and substrate composition; and coupled with visual observations of sDPS green sturgeon in the pool in 2011, 2016 and 2017, CDFW staff focused sturgeon egg mat sampling in this habitat unit (**Figure 1**). CDFW conducted a spawning survey in 2017 in the pool below the DPD but did not collect any sturgeon eggs, although several sDPS green sturgeon were observed holding in the pool between 14 June through 2 August 2017. However, it is possible that sDPS green sturgeon spawning did occur in the DPD pool in 2017. The limited number of egg mats deployed in the 2017 study coupled with the patchiness of egg distribution of spawning sturgeon (Carrofino *et. al.* 2010) likely limited the ability to detect potential sDPS green sturgeon spawning events in 2017.

Methods

Egg mats were constructed by securing a furnace filter insert to a 76×107×5-cm rectangular steel frame rigged with a 9.5 mm diameter braided polypropylene rope attachment bridle. A 9.5 mm diameter buoy line of sufficient length (depending on depth), and a 10-inch diameter inflatable buoy to mark the egg mat location from the surface and facilitate retrieval. Factors considered for mat deployment sites included presence of sDPS green sturgeon as determined by visual observation or DIDSON imagery, and depth, flow and substrate regimes as reported in the literature. Once a suitable sampling site was

selected, the mat was deployed by gradually lowering it to the river bottom from the bow of the boat while holding the boat stationary in the current. When the egg mat reached the river bottom, the buoy was deployed and observed for several minutes to insure the egg mat remained in place. Deployment date, water depth and water temperature were recorded at mat deployment site. Yuba River flow during site visits was obtained from the United States Geological Survey gage near Marysville (CDEC 2018). Egg mats were retrieved by slowly hauling in the float line to avoid dislodging adhered sturgeon eggs and gently lifting the mat into the boat. Two CDFW staff conducted a thorough visual inspection of each egg mat to check for sturgeon eggs prior to re-deployment.

Sampling was initiated on 1 May 2018 and terminated on 27 June 2018 for a total sampling period of 52 days. CDFW staff initially deployed four egg mats at the Daguerre Point Dam pool site for the first two weeks of the study. Two additional egg mats were deployed on 15 May 2018. Two more egg mats were deployed on 5 June 2018 for the duration of the study. Site visits to check egg mats were conducted on 8, 15, 22, and 29 May; and 5, 8, 15, and 27 June. Egg mats were numbered as mats 1-8 from south to north (Figure 1).

Results

CDFW staff made visual observations of between two and at least six adult sDPS green sturgeon holding in the pool below the Daguerre Point Dam during each site visit. In addition, eight adult green sturgeon were confirmed to have entered the Yuba River in spring of 2018 based on detection at a passive integrated transponder array in the lower portion of the river (C. Purdy personal communication with R. Kurth on 29 June 2018). On 15 June 2018, CDFW staff observed approximately 270 sturgeon eggs deposited on mat number 4 (**Figure 2**). Of these, 30 eggs were vouchered for species verification and developmental staging to determine a spawning date. The mat was then carefully lowered to the bottom as near as possible to its original location. No other sturgeon eggs were collected during the sampling period. Sampling was terminated on 27 June 2018 (see Discussion). Species-level identification of the eggs was made using the *Dichotomous Key to Fish Eggs of the Sacramento-San Joaquin River Delta* (Reyes 2011). Based on the key characteristics of egg diameter and color, all eggs vouchered were determined to be green sturgeon eggs. Genetic verification will be conducted in the near future. Habitat parameters such depth (range 7.8 to 11.2 ft), substrate (cobble, gravel), and flow (0.5 to 2 feet per second) at sites selected for egg mat deployment were consistent with green sturgeon spawning habitat reported in the literature (Klimley *et. al.* 2015, Poytress *et. al.* 2015). American shad (*Alosa sapidissima*) were collected from several of the egg mats on 15 May 2018. No other fish eggs were observed on the egg mats.

Benthic macroinvertebrates such as stonefly nymphs (*Calinuria californica* and *Hesperoperla pacifica*), caddisfly larvae (Hydropsychidae, Glossosomatidae, and mayfly larvae (Baetidae, Heptageniidae) were commonly observed on the egg mats. Other fish species commonly observed in the DPD plunge pool

during site visits included adult Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*), adult steelhead or rainbow trout (*O. mykiss*), Sacramento sucker (*Catostomus occidentalis*), American shad (*Alosa sapidissima*), and striped bass (*Morone saxatilis*).

Yuba River flows during the sampling period ranged from 2,662 cfs on 1 May 2018 to 1,543 cfs on 15 June 2018 (**Figure 3**). Water temperatures over the duration of the study ranged from 12° C to 14° C, which is within the range documented during spawning events for green sturgeon on the Sacramento and Feather rivers (Poytress *et. al.* 2015, Seesholtz *et. al.* 2015). Water depth, estimated flow velocity, and substrate composition at sampling sites were also within ranges reported in the literature at sturgeon spawning sites. **Table 1** presents deployment and retrieval dates and total mat deployment days by site. **Table 2** presents site depths, estimated flow velocities, dominant substrates, and water temperature by site.

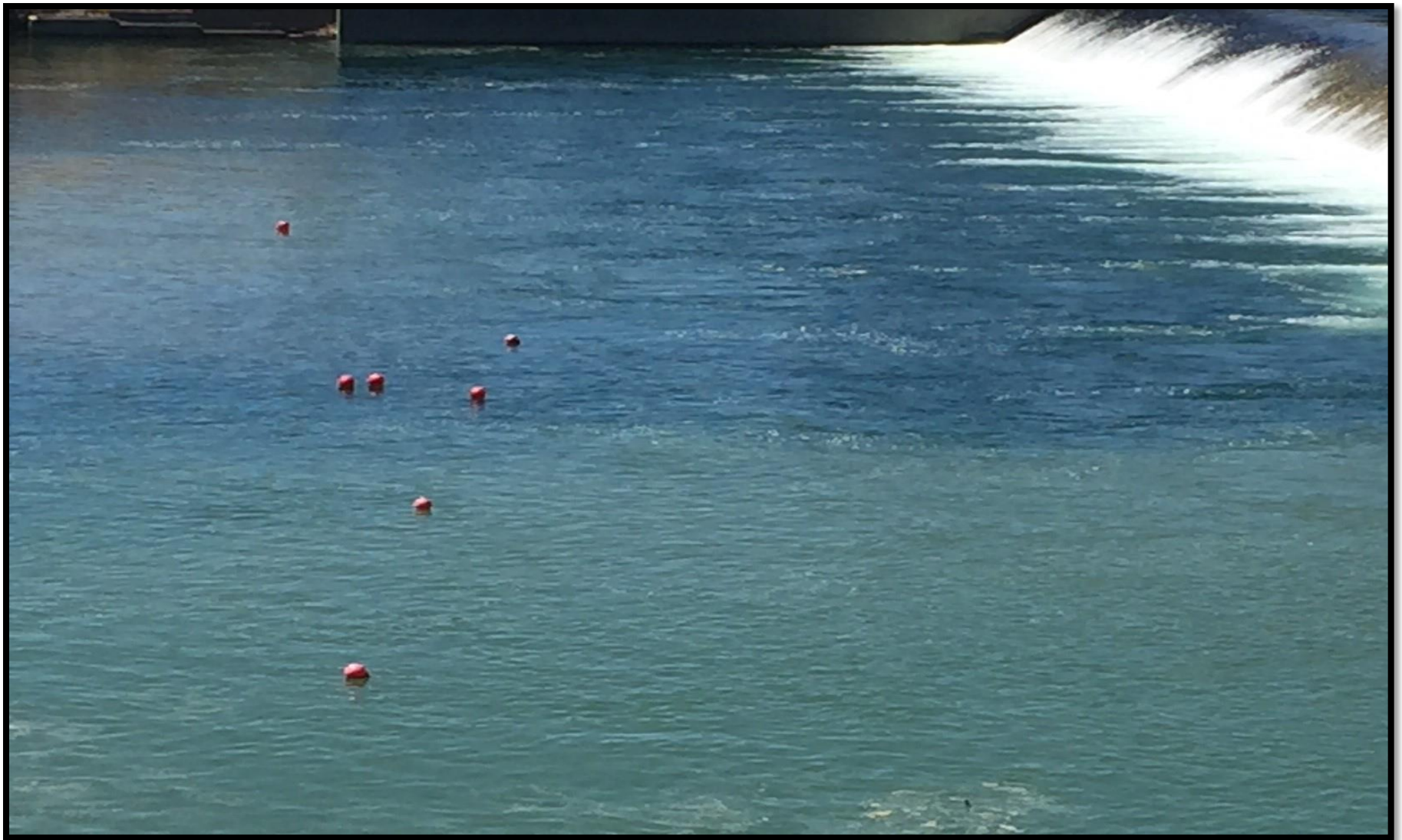


Figure 1. Approximate egg mat locations; 5 June through 27 June 2018, Yuba River Sturgeon Spawning Study. Mats are located approximately 2 to 12 meters upstream of the buoys depending on buoy line length. Turbidity plume from South Yuba Water District dredging activities observed upstream of Daguerre Point Dam on 21 June 2018 is evident in the lower half of the photograph.



Figure 2. sDPS green sturgeon eggs deposited on Mat-4 2018 Yuba River Sturgeon Spawning Study. Photograph taken 15 June 2018.

Table 1. Deployment and retrieval dates, total sampling days; and number of sturgeon eggs sampled, 2018 Yuba River Sturgeon Spawning Study.

| Deployment date | Retrieval date | Total sampling days | Number of sturgeon eggs; notes |
|-----------------|----------------|---------------------|--|
| 5/1/2018 | 5/8/2018 | 7 | 0; observed several green sturgeon rolling on north side of pool; moved mats from south side to north side. |
| 5/8/2018 | 5/15/2018 | 14 | 0; observed several green sturgeon rolling on north side of pool; moved mats from south side to north side; deployed Mats 5 and 6 on 5/15/2018; prickly sculpin on Mat-2 and Mat-3 |

| Deployment date | Retrieval date | Total sampling days | Number of sturgeon eggs; notes |
|-----------------|----------------|---------------------|---|
| 5/15/2018 | 5/18/2018 | 17 | 0; observed several green sturgeon, 10- 20 American shad eggs on several mats |
| 5/18/2018 | 5/22/2018 | 21 | 0; observed two green sturgeon on south side of pool. |
| 5/22/2018 | 5/29/2018 | 28 | 0; observed at least six green sturgeon on south side of pool; concentrated mat deployment in the middle to south side of pool. |
| 5/29/2018 | 6/05/2018 | 35 | 0; observed at least four green sturgeon on south side of pool. |
| 6/05/2018 | 6/08/2018 | 38 | 0; observed at least four green sturgeon on south side of pool; deployed Mats 7 and 8 on 6/08/2018. |
| 6/08/2018 | 6/15/2018 | 45 | Observed approximately 270 sturgeon eggs on Mat-4; vouchered 30 eggs and returned Mat-4 to same location; observed at least 5 adult green sturgeon on south side of pool. |
| 6/15/2018 | 6/27/2018 | 52 | 0; egg mats removed; CDFW dive team observed up to 20 green sturgeon in pool. |

Table 2. Initial site depth, water temperature range, estimated flow velocity, and dominant substrates; 2018 Yuba River Sturgeon Spawning Study.

| Mat # | Initial depth (ft) | Temperature range (° C) | Estimated surface velocity (ft/s) | Dominant substrates |
|-------|--------------------|-------------------------|-----------------------------------|---------------------|
| 1 | 10.6 | 12-14 | 0.5 | Gravel, cobble |
| 2 | 9.5 | 12-14 | 0.5 | Cobble, gravel |
| 3 | 11.2 | 12-14 | 1 | Cobble, gravel |
| 4 | 9.5 | 12-14 | 1.5 | Cobble, gravel |
| 5 | 8.6 | 12-14 | 1.5 | Cobble, gravel |
| 6 | 7.8 | 12-14 | 2 | Cobble, gravel |
| 7 | 10 | 12-14 | 2 | Cobble, gravel |
| 8 | 9.3 | 12-14 | 2 | Cobble, gravel |

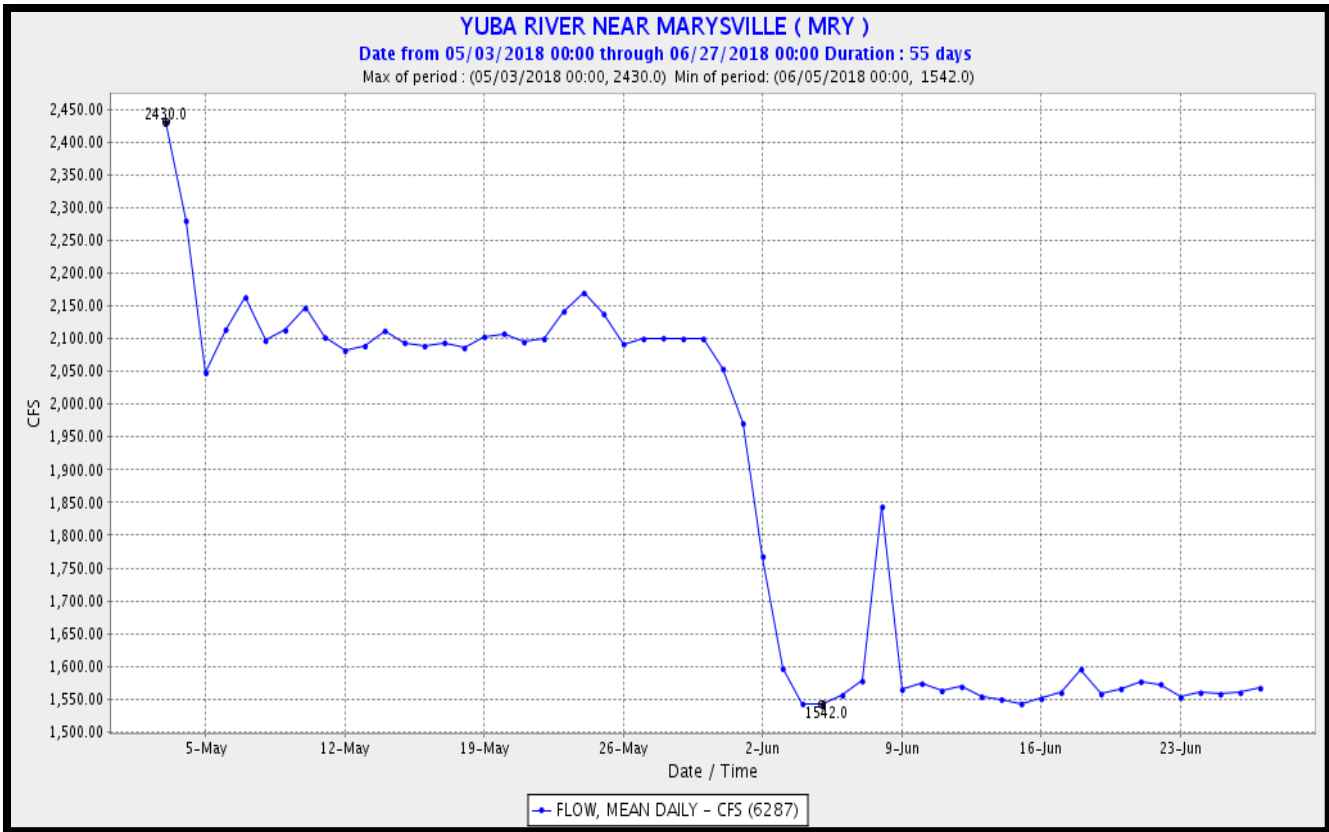


Figure 3. Yuba River mean daily flow at Marysville, 1 May through 27 June 2018 (CEDC 2018).

Discussion

The collection of sDPS green sturgeon eggs on 15 June 2018 is the first time that green sturgeon spawning has been documented in the Yuba River. DWR has documented green sturgeon spawning in the Feather River in 2011 (Seesholtz *et. al.* 2014) 2016, and 2017. DWR staff collected green sturgeon larvae in the Feather River downstream of the confluence with the Yuba River on 12 June 2018 but did not collect any green sturgeon eggs at their Feather River sampling sites (personal communication with A. Seesholtz). Therefore, it is possible that the larvae could have hatched from eggs spawned from an earlier spawning event in the Yuba River.

Green sturgeon eggs are reported to hatch at 144 to 192 hours (6 to 8 days) at 15.7° C (Deng *et. al.* 2002). The water temperature recorded on the 15 June site visit when the green sturgeon eggs were collected was 14° C, which would likely result in a somewhat longer incubation time. However, no green sturgeon eggs were observed on Mat-4 on 27 June 2018. Although it is possible that at least some of the eggs remaining on the mats hatched in the 12 days between site visits, it is reasonable to expect to see some unfertilized eggs on the mat. Green sturgeon larvae disperse at approximately 12 days post-

hatch, although (Kynard *et. al.* 2005), so it is possible that any larvae surviving predation as eggs or newly hatched larvae would be present on the egg mats. A more likely explanation for the lack of observed eggs is predation. An abundance of several species of fish known to prey on fish eggs including steelhead/rainbow trout (*Oncorhynchus mykiss*), Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychocheilus grandis*), prickly sculpin (*Cottus asper*), and striped bass (*Morone saxatilis*) occur in the Daguerre Point Dam pool. Since passage of fish through the fish ladders and around the low head dam is likely limited to salmonids, the dam likely concentrates predatory fish in the pool and contributes to high predation rates on sturgeon eggs and newly emerging larvae. Removal of the Daguerre Point Dam would provide access to additional upstream habitat in the lower Yuba River for sDPS green sturgeon and would also likely decrease predator densities during spawning events. Of additional concern was in-water work noted occurring immediately upstream of DPD on 21-22 June 2018. Although sediment deposition resulting from the in-water work was not documented in the DPD plunge pool, CDFW staff noted an increase in turbidity in the DPD plunge pool associated with the in-water work when the excavator crossed the channel upstream of the DPD at the end of the 21 June 2018 work shift. Depending on the extent of in-channel work, fine sediment could have been mobilized and been deposited in the DPD pool and impacted SDPS green sturgeon eggs or newly hatched larvae.

National Marine Fisheries Service (NMFS) 4(d) permit 21582 authorized CDFW for a directed lethal take of up to 100 sDPS green sturgeon eggs. NMFS and CDFW 4(d) Fisheries Branch Research Permitting staff were notified of the collection of approximately 270 eggs on 18 June 2018 as there was concern that the eggs remaining on the mat would be considered lethal take. Although the mat was replaced after vouchering 30 eggs, those eggs remaining on the mat would likely be subjected to increased predation and the larvae subjected to potential entanglement with the mat substrate upon hatching. Therefore, it was agreed the remaining eggs were considered lethal take and sampling would be terminated for the 2018 study year.

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